

REPLACEMENT ABSTRACT

Tubulars for monitoring subsurface reservoir characteristics in directed orientations. Elongated tubulars for permanent subsurface disposal are equipped with antennas adapted to transmit or receive electromagnetic energy. A tilted antenna is disposed within a groove on the tubular exterior. The groove includes a sealed opening to allow for passage of electromagnetic energy therethrough and the antenna is disposed within the groove in alignment with the opening such that the antenna is substantially perpendicular to the opening at the intersection. Methods for subsurface reservoir monitoring using the tubulars are also presented.